

ABOVEGROUND BIOMASS OF LONGLEAF PINE IN A NATURAL SAWTIMBER STAND IN SOUTHERN ALABAMA

by

Michael A. Taras

and

Alexander Clark III



Forest Service - U.S. Department of Agriculture
Southeastern Forest Experiment Station
Asheville, North Carolina

Conversion factors: English to metric

<u>Multiply</u>		<u>By</u>		<u>To Obtain</u>
Inches	x	2.540	=	centimeters
Feet	x	.3048	=	meters
Pounds	x	.4536	=	kilograms
Cubic feet	x	.02832	=	cubic meters
Pounds per cubic foot	x	16.02	=	kilograms per cubic meter

All English units of measure in this report can be converted to metric units by multiplying by the appropriate conversion factor listed above.

ABOVEGROUND BIOMASS OF LONGLEAF PINE IN A NATURAL SAWTIMBER STAND IN SOUTHERN ALABAMA¹

by

Michael A. Taras, Principal Wood Scientist

and

Alexander Clark III, Wood Scientist
Forestry Sciences Laboratory
Athens, Georgia

Abstract.--Longleaf pine trees 6 to 18 inches d.b.h. were selected from a natural, uneven-aged sawtimber stand in southern Alabama to determine weight and volume of aboveground biomass. On the average, 85 percent of the dry weight of the total tree was wood, 11 percent was bark, and 4 percent was needles. The average tree sampled had 88 percent of its wood in the stem and 12 percent in the crown. Trends in biomass proportions are discussed. Specific gravity, moisture content, and green weight per cubic foot are presented for the total tree and its components. Tables developed with regression equations predict weight and cubic foot volume of the total tree and its components by d.b.h. and total height classes.

Keywords: Pinus palustris Mill., weight, volume, prediction equations, component proportions, biomass.

This is the third in a series of reports on the aboveground biomass of southern pine sawtimber trees. It contains information on longleaf pine (Pinus palustris Mill.). The first two papers were on loblolly pine (Pinus taeda L.)² and shortleaf pine (P. echinata Mill.).³

This paper reports weights and volumes of various tree components (wood, bark, crown, branches, and foliage) as well as equations for predicting these components. The term total tree in this study refers only to the aboveground portion of the tree and does not include stump and roots.

¹This study was conducted by the Southeastern Forest Experiment Station in cooperation with and through the financial assistance of the Range, Timber, and Wildlife Program Area of Region 8 of the National Forest System. Field personnel were provided by the Conecuh National Forest.

²Taras, Michael A., and Alexander Clark III. 1975. Aboveground biomass of loblolly pine in a natural, uneven-aged sawtimber stand in central Alabama. *Tappi* 58(2): 103-105.

³Clark, Alexander III, and Michael A. Taras. 1976. Biomass of shortleaf pine in a natural sawtimber stand in northern Mississippi. USDA For. Serv. Res. Pap. SE-146, 32 p. Southeast. For. Exp. Stn., Asheville, N.C.

PROCEDURE

FIELD

A stratified random sample of 47 trees was selected from a natural, uneven-aged longleaf pine stand on the Conecuh National Forest in southern Alabama. Site index (age 50) averaged 80. Three to twelve trees from each even-inch d.b.h. class from 6 to 18 inches were selected. The sample trees had an average d.b.h. of 13.2 inches and an average total height of 80 feet. Means and ranges of tree measurements are shown in table 1.

After felling and limbing, the main stem of each tree was bucked into merchantable saw logs and pulpwood. Saw logs 8 to 16 feet long were cut from the main stem to a 6-inch d.i.b. or merchantable top. All material above saw-log merchantability to a 2-inch top was classed as pulpwood. The crown was cut up and segregated into four categories: [1] large branches (≥ 2.0 inches d.o.b.), [2] medium branches (≥ 0.6 and ≤ 1.9 inches d.o.b.), [3] small branches (≤ 0.5 inches d.o.b.), and [4] needles. The tip of the stem (2 inches d.i.b. to top) was included as branch material in the analysis. All crown material and pulpwood were weighted to the nearest 0.25 pound. Saw logs were weighed individually.

Moisture content and specific gravity of wood and bark were determined from disks removed at the butt of each tree, at each saw-log bucking point, and at points where d.i.b. measured 4 and 2 inches. Disks were also taken from branches randomly selected from each branch category. A sample of needles was selected for determination of needle moisture content. The disks were weighed and calipered with and without bark immediately after being sawed. A representative sample of bark and wood was removed from each disk, weighed, and sealed in a polyethylene bag for laboratory analysis.

Table 1.--Means and ranges of measurements of longleaf pine in each d.b.h. class sampled

D.b.h. class (inches)	Sample trees	D.b.h.		Total height		Merchantable height ^{1/}		Age		Form class	
		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
	Number	Inches		Feet		Years					
6	3	6.0	5.9 - 6.1	59	56-60	--	--	34	32-35	--	--
8	3	8.0	7.9 - 8.2	64	63-66	17	16-19	35	35-36	79	76-85
10	8	10.2	9.8 - 10.5	71	59-79	40	34-48	43	39-48	80	75-83
12	7	12.1	11.6 - 12.4	82	73-88	54	39-62	57	49-63	84	82-87
14	7	14.1	13.8 - 14.4	84	77-90	55	40-64	55	44-61	82	79-86
16	12	16.0	15.6 - 16.7	86	80-94	58	48-70	61	53-66	85	80-88
18	7	17.6	17.1 - 18.9	88	77-97	58	36-73	64	59-69	83	80-85
All classes	47	13.2	5.9 - 18.9	80	56-97	48	16-73	53	32-69	82	75-88

^{1/} Height to 6-inch d.i.b. or merchantable top.

LABORATORY

Specific gravity was computed from green volume and oven-dry weight. Moisture content samples were dried to a constant weight at 103° C, and moisture content was computed on an oven-dry basis. Percentage of bark was determined on a weight basis from cross-section samples. Weighted values for moisture content, specific gravity, and percentage of bark in the stem, branches, and total tree were calculated by weighting disk values in proportion to the volume of the component each represented. Weighted moisture content values were used to convert component green weights to oven-dry weights.

The following equation was used to calculate green weight per cubic foot separately for wood and bark on the basis of the weighted values for specific gravity and moisture content:

$$\text{Green weight per cubic foot} = \left(1 + \frac{\text{weighted moisture content in percent}}{100} \right) \times \frac{1}{(62.4 \times \text{weighted specific gravity})} \quad (1)$$

The green cubic foot volume of wood and bark was computed by dividing component weight by the component's green weight per cubic foot. Green cubic foot volume of wood and bark was computed by adding the green volume of wood to the green volume of bark.

ANALYSIS

Simple linear regression equations for predicting green and dry weight of wood, bark, and needles in the total tree and its components were developed with d.b.h., total height, merchantable height, crown length, crown ratio, and form class as independent variables. Equations were also developed to predict green cubic foot volume of wood and bark separately and combined.

The best independent variables examined were d.b.h. and total height. Thus, tree and component weights and volumes were estimated with the equation

$$Y = b_0 + b_1 D^2 Th + e \quad (2)$$

where: Y = weight or volume of component,
D = d.b.h. in inches,
Th = total tree height in feet,
e = experimental error, and
b₀, b₁ = constants.

Grouping of the data into D²Th classes indicated that the variance of Y increased with increasing D²Th. Thus, a logarithmic transformation was used to make the variance more nearly homogeneous and meet this basic assumption of regression analysis. The final form of the equation used to predict weight and volume of the total tree and each component sampled was

$$\log_{10} Y = b_0 + b_1 \log_{10} (D^2 Th) \quad (3)$$

RESULTS

TOTAL TREE BIOMASS

Green and dry weight of the total tree and proportions of tree weight in wood, bark, and needles are shown in table 2. Green weight of the total tree ranged from 396 pounds for a 6-inch tree to 5,122 pounds for an 18-inch tree. On the average, the trees sampled had 85 percent of their dry weight in wood, 11 percent in bark, and 4 percent in needles. The proportion of tree weight in wood increased and the proportion in bark decreased as tree size increased from 6 to 12 inches d.b.h. and then remained relatively constant in trees 12 inches d.b.h. and larger. The proportion of tree weight in needles did not change consistently with tree size and averaged 4 percent. Proportions of the various tree components computed on a dry basis varied slightly from those computed on a green basis because of differences in component moisture content (table 2).

Table 2.--Average green and dry weight of the total tree and proportions of the tree in wood, bark, and needles for longleaf pine trees 6 to 18 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree green weight	Tree component proportions (green)			Total tree dry weight	Tree component proportions (dry)		
				Wood	Bark	Needles		Wood	Bark	Needles
	Feet	Number	Pounds	- - - Percent - - -			Pounds	- - - Percent - - -		
6	59	3	396	79	14	7	213	78	17	5
8	64	3	859	79	13	8	451	79	15	6
10	71	8	1,378	83	11	6	740	82	13	5
12	82	7	2,252	85	10	5	1,242	85	11	4
14	84	7	3,076	84	10	6	1,718	84	11	5
16	86	12	4,268	86	9	5	2,333	86	10	4
18	88	7	5,122	84	11	5	2,765	84	12	4
Average	--	--	2,961	85	10	5	1,617	85	11	4

When the trees were viewed as being composed of stem and crown, proportion of the tree weight in stem material decreased and proportion in crown material (branches plus needles) increased with increasing tree size (table 3). Proportion of tree dry weight in crown material ranged from 13 percent in the small trees to 20 percent in the large trees and averaged 17 percent. This average value is within 1 percent of the averages previously reported in this series for loblolly pine (16 percent) and shortleaf pine (18 percent). As with the other two species, the increase in proportion of crown material was due to an increase in proportion of branch material and not to an increase in the proportion of needles.

The green and dry weight of all wood in the tree and the distribution of wood throughout the tree are presented in table 4. On the average, the trees had 89 percent of their dry wood weight in the main stem (to a 2-inch top) and 11 percent in branches. The proportion of wood in the main stem decreased and that in the branches increased as tree size increased. The increase in proportion of wood in branches was due to an increase in large branch material in

Table 3.--Average green and dry weight of the total tree and proportions of the tree in main stem^{1/} and crown (branches and needles) for longleaf pine trees 6 to 18 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree green weight	Tree component proportions (green)			Total tree dry weight	Tree component proportions (dry)		
				Stem	Crown			Stem	Crown	
					Branches	Needles			Branches	Needles
	Feet	Number	Pounds	- - -	Percent	- - -	Pounds	- - -	Percent	- - -
6	59	3	396	85	8	7	213	87	8	5
8	64	3	859	84	8	8	451	85	9	6
10	71	8	1,378	84	10	6	740	86	9	5
12	82	7	2,252	85	10	5	1,242	86	10	4
14	84	7	3,076	82	12	6	1,718	84	12	4
16	86	12	4,268	81	14	5	2,333	83	13	4
18	88	7	5,122	78	17	5	2,765	80	16	4
Average	--	--	2,961	81	14	5	1,617	83	13	4

^{1/} Stem material to 2-inch d.i.b. top.

Table 4.--Average green and dry weight of wood in the total tree and distribution of wood in main stem^{1/} and branches for longleaf pine trees 6 to 18 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree wood weight	Proportion of wood in--						
				Main stem			Branches			
				Saw log	Pulpwood	Total stem	Large	Medium	Small	All branches
	Feet	Number	Pounds	Percent						
GREEN										
6	59	3	314	--	94	94	0	4	2	6
8	64	3	681	70	24	94	0	4	2	6
10	71	8	1,142	77	15	92	3	3	2	8
12	82	7	1,908	84	8	92	4	2	2	8
14	84	7	2,582	82	8	90	6	2	2	10
16	86	12	3,667	80	8	88	8	2	2	12
18	88	7	4,306	78	7	85	10	3	2	15
Average	--	--	2,504	79	9	88	7	3	2	12
DRY										
6	59	3	167	--	94	94	0	4	2	6
8	64	3	357	74	20	94	0	4	2	6
10	71	8	610	80	13	93	3	3	1	7
12	82	7	1,054	86	7	93	3	2	2	7
14	84	7	1,448	83	8	91	5	2	2	9
16	86	12	2,009	82	7	89	7	2	2	11
18	88	7	2,325	80	6	86	10	3	1	14
Average	--	--	1,369	81	8	89	6	3	2	11

^{1/} Stem material to 2-inch d.i.b. top.

larger trees. The proportion of wood in the pulpwood section of a tree decreased and proportion in the saw-log section increased as tree size increased. On the average, the trees contained 81 percent of their dry wood in saw-log material and 8 percent in pulpwood.

The weight and distribution of bark in the tree are presented in table 5. As tree size increased, the proportion of bark in the main stem decreased and the proportion of bark in the branches increased. This increase in proportion of bark in branches was due to an increase in the proportion of large branches in large trees. On the average, 58 percent of all dry bark in the tree was in saw-log material, 7 percent was in pulpwood, and 35 percent was in branches.

Table 5.--Average green and dry weight of bark in the total tree and distribution of bark in main stem^{1/} and branches for longleaf pine trees 6 to 18 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree bark weight	Proportion of bark in--						
				Main stem			Branches			
				Saw log	Pulpwood	Total stem	Large	Medium	Small	All branches
	Feet	Number	Pounds	Percent						
GREEN										
6	59	3	56	--	78	78	0	7	15	22
8	64	3	110	55	19	74	0	9	17	26
10	71	8	157	59	12	71	6	10	13	29
12	82	7	221	59	8	67	7	9	17	33
14	84	7	321	56	7	63	10	8	19	37
16	86	12	383	56	5	62	12	8	18	38
18	88	7	538	53	5	58	16	10	16	42
Average	--	--	296	55	8	63	11	9	17	37
DRY										
6	59	3	36	--	79	79	0	8	13	21
8	64	3	66	58	17	75	0	9	16	25
10	71	8	96	64	10	74	5	9	12	26
12	82	7	134	62	7	69	6	8	17	31
14	84	7	194	59	7	66	9	7	18	34
16	86	12	232	58	6	64	12	7	17	36
18	88	7	320	56	5	61	14	9	16	39
Average	--	--	179	58	7	65	11	8	16	35

^{1/} Stem material to 2-inch d.i.b. top.

CROWN BIOMASS

When the crown was analyzed as a separate entity composed of branchwood, branchbark, and needles, the proportion of crown weight in wood increased, the proportion in needles decreased, and the proportion in bark decreased as tree size increased (table 6). On the average, 53 percent of the dry weight of the crown was in wood, 22 percent was in bark, and 25 percent was in needles.

Branches made up 8 to 16 percent of the dry weight of the total tree, depending on tree size (table 3). On the average, 24 percent of the branch dry weight was in small branches, 24 percent was in medium branches, and 52 percent was in large branches. This size distribution of branches varied greatly with tree size (fig. 1). The proportion of large branches increased rapidly with increasing tree size, and the proportion of medium and small branches decreased with increasing tree size. When branches were separated into wood and bark, large branches averaged 83 percent wood and 17 percent bark, medium branches averaged 71 percent wood and 29 percent bark, and small branches averaged 42 percent wood and 58 percent bark.

Table 6.--Average green and dry weight of the crown and proportions of the crown in wood, bark, and needles for longleaf pine trees 6 to 18 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Crown weight (green)	Crown proportion (green)--			Crown weight (dry)	Crown proportion (dry)--		
				Branch- wood	Branch- bark	Needles		Branch- wood	Branch- bark	Needles
	Feet	Number	Pounds	Percent			Pounds	Percent		
6	59	3	58	35	22	43	28	36	28	36
8	64	3	141	31	21	48	66	33	24	43
10	71	8	214	42	21	37	103	43	24	33
12	82	7	348	44	21	35	173	45	24	31
14	84	7	557	48	21	31	279	49	24	27
16	86	12	802	55	18	27	389	55	21	24
18	88	7	1,148	56	20	24	562	57	22	21
Average	--	--	560	52	19	29	274	53	22	25

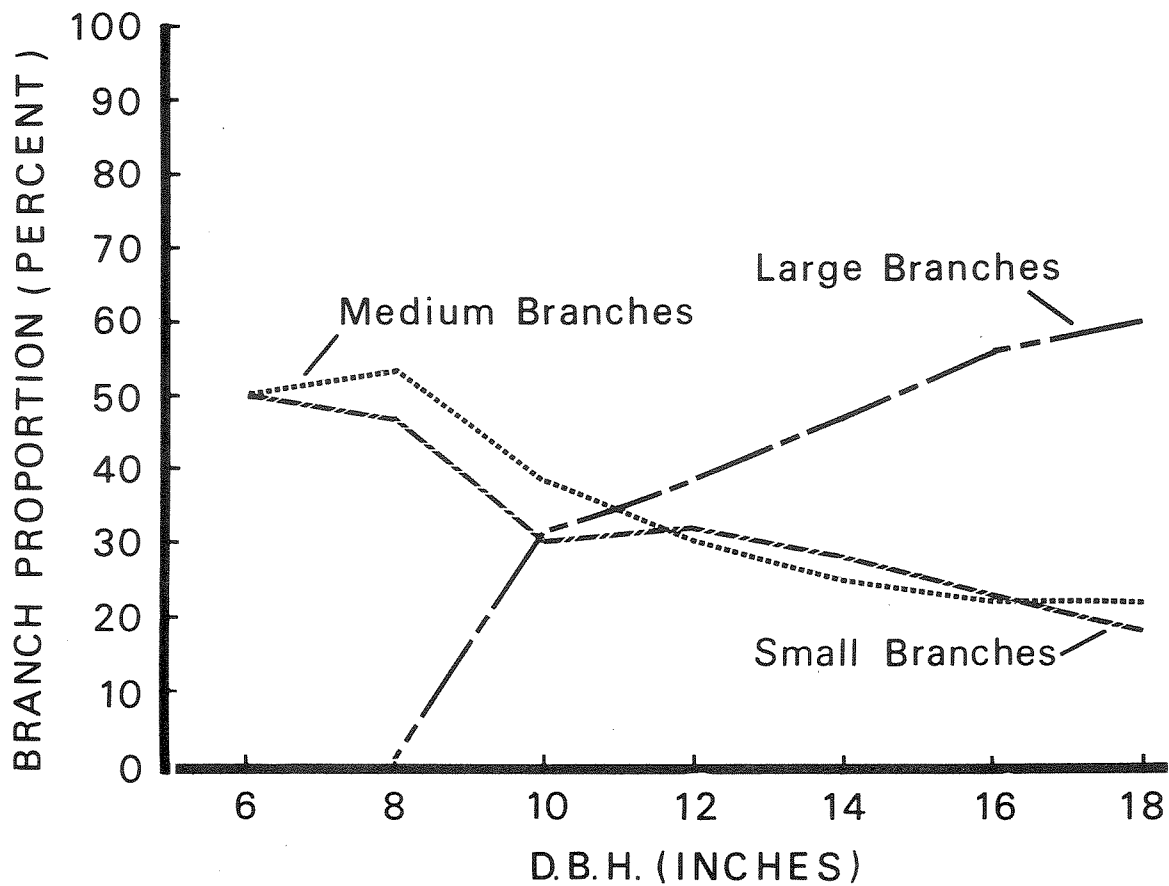


Figure 1.--Proportion of branches in crown by tree size.

MAIN STEM BIOMASS

When the main stem was analyzed separately, the proportion of stem weight in wood increased and the proportion in bark decreased as tree size increased (table 7). On the average, 91 percent of the dry weight of the stem was wood and 9 percent was bark. Similar proportions of wood and bark in the main stem were previously reported in this series for loblolly and shortleaf pines.

Table 7.--Average green and dry weight of the stem^{1/} and proportions of the stem in wood and bark for longleaf pine trees 6 to 18 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Main stem weight (green)	Stem proportions in green--		Main stem weight (dry)	Stem proportions in dry--	
				Wood	Bark		Wood	Bark
	Feet	Number	Pounds	- -Percent- -		Pounds	- -Percent- -	
6	59	3	338	87	13	185	85	15
8	64	3	718	89	11	384	87	13
10	71	8	1,164	90	10	636	89	11
12	82	7	1,904	92	8	1,069	91	9
14	84	7	2,519	92	8	1,439	91	9
16	86	12	3,466	93	7	1,944	92	8
18	88	7	3,974	92	8	2,201	91	9
Average	--	--	2,401	92	8	1,343	91	9

^{1/} Stem material to 2-inch d.i.b. top.

PHYSICAL PROPERTIES

Wood and bark specific gravity, moisture content, and green weight per cubic foot for the total tree and its components are presented in table 8. Wood specific gravity for the total tree averaged 0.552--the same as the average specific gravity reported for the species in southeastern Alabama.⁴ Wood specific gravity for pulpwood averaged 0.509, which is considerably lower than the average for the saw-log portion of the tree and slightly higher than that for the branches. Bark specific gravity was consistently lower than wood specific gravity, averaging 0.401 for the total tree, 0.405 for the main stem, and 0.393 for branches. Bark specific gravity in all tree components was higher for longleaf pine than has been reported previously in this series for shortleaf or loblolly pines.

Wood moisture content averaged 84 percent for the total tree, 82 percent for the main stem, and 103 percent for the branches (table 8). Wood moisture content was considerably higher for pulpwood (106 percent) than for saw logs (79 percent).

⁴U.S. Forest Products Laboratory. 1972 (rev. 1975). Properties of major southern pines. Part I - Wood density survey, by H. E. Wahlgren and D. R. Schumann. Part II - Structural properties and specific gravity, by B. A. Bendtsen, R. L. Ethington, and W. L. Galligan. USDA For. Serv. Res. Pap. FPL 176-177, 76 p. U.S. For. Prod. Lab., Madison, Wis.

Table 8.--Average wood and bark specific gravity, moisture content, and weight per cubic foot for longleaf pine trees and tree components

Tree component	Average and standard deviation		
	Specific gravity	Moisture content	Green weight per cubic foot
		<u>Percent</u>	<u>Pounds</u>
<u>WOOD</u>			
Total tree	0.552 \pm 0.029	84 \pm 8	63.3 \pm 2.2
Saw log	.565 \pm .034	79 \pm 8	63.1 \pm 2.5
Pulpwood	.509 \pm .043	106 \pm 16	65.1 \pm 2.5
Main stem	.558 \pm .031	82 \pm 8	63.3 \pm 2.4
Branches	.489 \pm .029	103 \pm 12	61.8 \pm 3.0
<u>BARK</u>			
Total tree	.401 \pm .022	65 \pm 7	41.3 \pm 2.4
Saw log	.407 \pm .025	57 \pm 8	39.8 \pm 2.8
Pulpwood	.390 \pm .029	82 \pm 14	44.1 \pm 4.1
Main stem	.405 \pm .026	59 \pm 7	40.2 \pm 2.8
Branches	.393 \pm .028	78 \pm 12	43.4 \pm 2.7

On a total-tree basis, bark moisture content averaged 65 percent, which was lower than the corresponding value for wood (table 8). Bark moisture content was also lower for saw logs (57 percent) than for pulpwood (82 percent) or branches (78 percent). The higher moisture content in branches and pulpwood sections of the tree reflected the differences in the ratio of inner bark to outer bark and the differences in bark thickness in various parts of the tree.

Average wood weight per cubic foot did not vary greatly among tree components (table 8). Average green weight per cubic foot was lower for saw logs (63.1 pounds) than for pulpwood (65.1 pounds). Nevertheless, saw logs contained 2.7 pounds more wood per cubic foot than did pulpwood because of their higher specific gravity.

Bark was consistently lower in green weight per cubic foot than wood (table 8). Bark green weight per cubic foot averaged 41.3 pounds for the total tree, 39.8 pounds for saw logs, 44.1 pounds for pulpwood, and 43.4 pounds for branches. Branchbark weighed more per cubic foot than did the stembark because of its higher moisture content (78 percent vs. 59 percent). Green weight per cubic foot of wood and bark combined averaged 60.8 pounds for the total tree, 61.3 pounds in the main stem, and 56.3 pounds in branch material.

EQUATIONS

Equations were developed to predict weight and volume of the total tree and its components on the basis of the biomass of the 47 trees sampled. Those for predicting green and dry weights are in table 9, and those for predicting green cubic foot volumes are in table 10. Also included in tables 9 and 10 are the coefficient of determination and standard error of estimate for each equation. In most cases, the coefficients of determination indicate a high degree of linear association between the independent variable (D^2Th) and component

Table 9.--Regression equations for estimating green and dry weight of aboveground biomass of natural longleaf pine trees and tree components with d.b.h. and total height as independent variables

Weight (Y)	Regression equation ^{1/}	Coefficient of determination (R ²)	Standard error (S _{y.x}) ^{2/}
COMPLETE TREE (INCLUDING NEEDLES) ^{3/}			
Green	$\text{Log}_{10} Y = -0.68988 + 0.99194 \text{ Log}_{10} D^2\text{Th}$	0.99	0.031
Dry	$\text{Log}_{10} Y = -0.99717 + 1.00242 \text{ Log}_{10} D^2\text{Th}$	.99	.036
COMPLETE TREE (EXCLUDING NEEDLES) ^{3/}			
Green	$\text{Log}_{10} Y = -0.74607 + 0.99947 \text{ Log}_{10} D^2\text{Th}$	.99	.030
Dry	$\text{Log}_{10} Y = -1.03965 + 1.00795 \text{ Log}_{10} D^2\text{Th}$	.99	.035
ALL WOOD IN TREE ^{3/}			
Green	$\text{Log}_{10} Y = -0.88747 + 1.02133 \text{ Log}_{10} D^2\text{Th}$	.99	.031
Dry	$\text{Log}_{10} Y = -1.21543 + 1.03675 \text{ Log}_{10} D^2\text{Th}$	.99	.038
ALL BARK IN TREE ^{3/}			
Green	$\text{Log}_{10} Y = -1.05087 + 0.84066 \text{ Log}_{10} D^2\text{Th}$	.96	.056
Dry	$\text{Log}_{10} Y = -1.20218 + 0.82474 \text{ Log}_{10} D^2\text{Th}$	.96	.054
WOOD AND BARK IN SAW-LOG PORTION OF STEM FOR TREES > 9.5 INCHES D.B.H. ^{4/}			
Green	$\text{Log}_{10} Y = -0.97687 + 1.02760 \text{ Log}_{10} D^2\text{Th}$	.96	.041
Dry	$\text{Log}_{10} Y = -1.22689 + 1.02819 \text{ Log}_{10} D^2\text{Th}$	.96	.045

continued

Table 9.--Regression equations for estimating green and dry weight of aboveground biomass of natural longleaf pine trees and tree components with d.b.h. and total height as independent variables (continued)

Weight (Y)	Regression equation ^{1/}	Coefficient of determination (R ²)	Standard error (S _{y.x}) ^{2/}
WOOD IN SAW-LOG PORTION OF STEM FOR TREES > 9.5 INCHES D.B.H. ^{4/}			
Green	$\log_{10} Y = -1.08665 + 1.04530 \log_{10} D^2Th$	0.96	0.043
Dry	$\log_{10} Y = -1.36758 + 1.05208 \log_{10} D^2Th$	.95	.048
BARK IN SAW-LOG PORTION OF STEM FOR TREES > 9.5 INCHES D.B.H. ^{4/}			
Green	$\log_{10} Y = -1.26502 + 0.83155 \log_{10} D^2Th$	.92	.051
Dry	$\log_{10} Y = -1.35097 + 0.80530 \log_{10} D^2Th$	.89	.057
WOOD AND BARK IN STEM FROM STUMP TO 2-INCH D.I.B. TOP ^{3/}			
Green	$\log_{10} Y = -0.65002 + 0.96146 \log_{10} D^2Th$	.99	.028
Dry	$\log_{10} Y = -0.96015 + 0.97497 \log_{10} D^2Th$	.99	.034
WOOD IN STEM FROM STUMP TO 2-INCH D.I.B. TOP ^{3/}			
Green	$\log_{10} Y = -0.78784 + 0.98563 \log_{10} D^2Th$	.99	.030
Dry	$\log_{10} Y = -1.13120 + 1.00588 \log_{10} D^2Th$	.99	.037
BARK IN STEM FROM STUMP TO 2-INCH D.I.B. TOP ^{3/}			
Green	$\log_{10} Y = -0.77468 + 0.72855 \log_{10} D^2Th$	.96	.046
Dry	$\log_{10} Y = -0.93976 + 0.71954 \log_{10} D^2Th$	.95	.053

continued

Table 9.--Regression equations for estimating green and dry weight of aboveground biomass of natural longleaf pine trees and tree components with d.b.h. and total height as independent variables (continued)

Weight (Y)	Regression equation ^{1/}	Coefficient of determination (R ²)	Standard error (S _{y,x}) ^{2/}
CROWN WEIGHT (INCLUDING BRANCHWOOD, BRANCHBARK, AND NEEDLES) ^{3/}			
Green	$\text{Log}_{10} Y = -2.00999 + 1.12764 \text{ Log}_{10} D^2\text{Th}$	0.91	0.111
Dry	$\text{Log}_{10} Y = -2.37618 + 1.14054 \text{ Log}_{10} D^2\text{Th}$	.90	.118
NEEDLES ^{3/}			
Green	$\text{Log}_{10} Y = -1.46928 + 0.87586 \text{ Log}_{10} D^2\text{Th}$	.90	.091
Dry	$\text{Log}_{10} Y = -1.90676 + 0.89244 \text{ Log}_{10} D^2\text{Th}$	.90	.094
WOOD AND BARK IN ALL BRANCH MATERIAL ^{3/}			
Green	$\text{Log}_{10} Y = -2.72222 + 1.25770 \text{ Log}_{10} D^2\text{Th}$	.90	.134
Dry	$\text{Log}_{10} Y = -2.95713 + 1.24480 \text{ Log}_{10} D^2\text{Th}$	.89	.141
WOOD IN ALL BRANCH MATERIAL ^{3/}			
Green	$\text{Log}_{10} Y = -3.22660 + 1.34140 \text{ Log}_{10} D^2\text{Th}$	.90	.147
Dry	$\text{Log}_{10} Y = -3.51387 + 1.33673 \text{ Log}_{10} D^2\text{Th}$	.88	.157
BARK IN ALL BRANCH MATERIAL ^{3/}			
Green	$\text{Log}_{10} Y = -2.49769 + 1.07628 \text{ Log}_{10} D^2\text{Th}$	.90	.116
Dry	$\text{Log}_{10} Y = -2.72978 + 1.07216 \text{ Log}_{10} D^2\text{Th}$	.89	.120

$$\frac{1}{\text{Log}_{10}} Y = b_0 + b_1 \text{ Log}_{10} D^2\text{Th}$$

where: Y = weight of tree or component in pounds,
D = d.b.h. in inches,
Th = total height in feet.

^{2/}Standard error of estimate in Log₁₀ form.

^{3/}Regression equations based on 47 trees 6 to 18 inches d.b.h.

^{4/}Regression equations based on 41 trees 10 to 18 inches d.b.h.

Table 10.--Regression equations for estimating green cubic foot volume of the aboveground biomass of natural longleaf pine trees and tree components with d.b.h. and total height as independent variables

Cubic foot volume (Y)	Regression equation ^{1/}	Coefficient of determination (R ²)	Standard error (S _{y.x}) ^{2/}
<u>TOTAL TREE^{3/}</u>			
Wood	Log ₁₀ Y = -2.80224 + 1.04936 Log ₁₀ D ² Th	0.99	0.027
Bark	Log ₁₀ Y = -2.54434 + 0.81138 Log ₁₀ D ² Th	.95	.061
Wood & bark	Log ₁₀ Y = -2.54553 + 1.00570 Log ₁₀ D ² Th	.99	.026
<u>STEM FROM STUMP TO SAW-LOG TOP FOR TREES > 9.5 INCHES D.B.H.^{4/}</u>			
Wood	Log ₁₀ Y = -3.00060 + 1.07344 Log ₁₀ D ² Th	.97	.040
Bark	Log ₁₀ Y = -2.88643 + 0.83568 Log ₁₀ D ² Th	.89	.059
Wood & bark	Log ₁₀ Y = -2.82198 + 1.04378 Log ₁₀ D ² Th	.97	.037
<u>STEM FROM STUMP TO 2-INCH D.I.B. TOP^{3/}</u>			
Wood	Log ₁₀ Y = -2.72558 + 1.01904 Log ₁₀ D ² Th	.99	.028
Bark	Log ₁₀ Y = -2.25358 + 0.69804 Log ₁₀ D ² Th	.94	.056
Wood & bark	Log ₁₀ Y = -2.47035 + 0.97145 Log ₁₀ D ² Th	.99	.025
<u>ALL BRANCH MATERIAL^{3/}</u>			
Wood	Log ₁₀ Y = -4.84899 + 1.30101 Log ₁₀ D ² Th	.89	.146
Bark	Log ₁₀ Y = -4.10690 + 1.07007 Log ₁₀ D ² Th	.89	.119
Wood & bark	Log ₁₀ Y = -4.26121 + 1.20985 Log ₁₀ D ² Th	.90	.131

$$\frac{1}{\log_{10}} Y = b_0 + b_1 \log_{10} D^2Th$$

where: Y = cubic feet of tree or component,
D = d.b.h. in inches,
Th = total height in feet.

^{2/} Standard error of estimate in Log₁₀ form.

^{3/} Regression equations based on 47 trees 6 to 18 inches d.b.h.

^{4/} Regression equations based on 41 trees 10 to 18 inches d.b.h.

weight or volume. Poorest associations occurred in equations developed to predict branch weight and volume. Crown components varied more than other tree components.

YIELD TABLES

The equations in tables 9 and 10 were used to develop tables of biomass weight and volume. These tables of predicted yields are presented in the Appendix. Predicted green and dry weights of wood, bark, and needles in the total tree, main stem, and crown are presented in tables 11 through 21 by d.b.h. and total height classes. Predicted green cubic foot volumes of wood and bark in the total tree, main stem, and branches are presented in tables 22 through 24.

Trees with the same d.b.h. and total height can vary considerably in weight and volume because of differences in crown size, moisture content, specific gravity, and taper. The yield tables presented in the Appendix should not be used indiscriminately over the range of longleaf pine without testing. Rather, they should be applied only to natural, closed stands which are similar in age, taper rate, and wood properties to the trees sampled.

Appendix

Table 11.--Predicted weight of total tree (wood, bark, and needles) for
longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- <u>Pounds</u> -----							
<u>GREEN^{3/}</u>							
6	346	415	483	552			
7	470	563	656	749			
8	612	734	855	976	1,097		
9	774	927	1,080	1,233	1,386	1,539	
10	953	1,142	1,331	1,520	1,708	1,896	2,084
11	1,152	1,380	1,608	1,836	2,064	2,291	2,518
12	1,369	1,640	1,911	2,182	2,452	2,722	2,992
13	1,604	1,923	2,240	2,557	2,874	3,191	3,507
14	1,859	2,227	2,595	2,962	3,330	3,696	4,063
15	2,131	2,554	2,976	3,397	3,818	4,239	4,659
16		2,902	3,382	3,861	4,340	4,818	5,295
17		3,273	3,814	4,354	4,894	5,433	5,972
18			4,272	4,877	5,482	6,086	6,689
19			4,756	5,430	6,102	6,775	7,446
20			5,265	6,011	6,756	7,500	8,244
<u>DRY^{4/}</u>							
6	184	221	258	296			
7	251	302	352	403			
8	328	394	460	526	592		
9	416	499	583	666	750	833	
10	514	617	720	823	926	1,029	1,132
11	622	747	871	996	1,121	1,246	1,371
12	740	889	1,037	1,186	1,335	1,483	1,632
13	869	1,044	1,218	1,393	1,567	1,742	1,916
14	1,009	1,211	1,413	1,616	1,818	2,021	2,223
15	1,158	1,390	1,623	1,855	2,088	2,320	2,553
16		1,583	1,847	2,111	2,376	2,641	2,906
17		1,787	2,086	2,384	2,683	2,982	3,281
18			2,339	2,674	3,009	3,344	3,679
19			2,607	2,980	3,353	3,727	4,101
20			2,889	3,303	3,717	4,131	4,545

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\text{Log}_{10} Y = -0.68988 + 0.99194 \text{ Log}_{10} D^2\text{Th.}$

^{4/} $\text{Log}_{10} Y = -0.99717 + 1.00242 \text{ Log}_{10} D^2\text{Th.}$

Table 12.--Predicted weight of all aboveground wood excluding bark for
longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- <u>Pounds</u> -----							
<u>GREEN</u> ^{3/}							
6	274	330	386	442			
7	375	452	529	606			
8	493	593	695	796	898		
9	627	755	883	1,013	1,142	1,272	
10	777	936	1,096	1,256	1,416	1,577	1,738
11	944	1,137	1,331	1,526	1,721	1,916	2,112
12	1,128	1,358	1,590	1,822	2,055	2,289	2,523
13	1,328	1,600	1,872	2,146	2,420	2,695	2,971
14	1,545	1,861	2,178	2,497	2,816	3,136	3,456
15	1,779	2,143	2,508	2,875	3,242	3,610	3,979
16		2,445	2,861	3,280	3,699	4,119	4,540
17		2,767	3,239	3,712	4,186	4,662	5,139
18			3,640	4,172	4,705	5,239	5,775
19			4,065	4,659	5,254	5,851	6,449
20			4,514	5,173	5,835	6,498	7,162
<u>DRY</u> ^{4/}							
6	144	174	205	235			
7	199	240	282	324			
8	262	317	372	427	482		
9	335	404	474	545	616	687	
10	416	503	590	678	766	854	943
11	507	613	719	826	933	1,041	1,149
12	608	734	861	989	1,118	1,247	1,376
13	717	867	1,017	1,168	1,319	1,472	1,625
14	837	1,011	1,186	1,362	1,539	1,716	1,894
15	965	1,166	1,368	1,571	1,775	1,980	2,186
16		1,333	1,564	1,796	2,029	2,264	2,499
17		1,511	1,773	2,037	2,301	2,567	2,833
18			1,997	2,293	2,591	2,890	3,190
19			2,233	2,565	2,898	3,233	3,568
20			2,484	2,853	3,223	3,595	3,969

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -0.88747 + 1.02133 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -1.21543 + 1.03675 \log_{10} D^2Th.$

Table 13.--Predicted weight of all aboveground bark for longleaf pine
trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- <u>Pounds</u> -----							
<u>GREEN</u> ^{3/}							
6	48	57	64	72			
7	63	73	83	93			
8	79	92	104	117	129		
9	96	112	127	142	157	172	
10	114	133	152	170	188	205	222
11	134	157	178	199	220	241	261
12	156	181	206	231	255	279	302
13	178	207	236	264	292	319	345
14	202	235	267	299	330	361	391
15	226	264	300	336	371	405	439
16		294	335	375	414	452	490
17		326	371	415	458	500	542
18			408	457	504	551	597
19			447	500	552	603	653
20			487	545	602	658	712
<u>DRY</u> ^{4/}							
6	30	35	40	45			
7	39	46	52	58			
8	49	57	64	72	79		
9	59	69	78	87	96	105	
10	71	82	93	104	115	125	135
11	83	96	109	122	134	146	158
12	95	111	126	140	155	169	183
13	109	126	144	160	177	193	208
14	123	143	162	181	200	218	235
15	138	160	182	203	224	244	264
16		178	202	226	249	271	294
17		197	223	249	275	300	324
18			246	274	302	329	356
19			268	300	330	360	390
20			292	326	359	392	424

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -1.05087 + 0.84066 \log_{10} D^2 \text{Th.}$

^{4/} $\log_{10} Y = -1.20218 + 0.82474 \log_{10} D^2 \text{Th.}$

Table 14.--Predicted weight of needles for longleaf pine trees 6 to 20

inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
-----Pounds-----							
<u>GREEN</u> ^{3/}							
6	24	28	32	36			
7	32	37	42	48			
8	40	47	54	60	67		
9	49	58	66	74	82	90	
10	59	69	79	89	99	108	118
11	70	82	94	105	117	128	139
12	81	95	109	122	136	149	162
13	93	110	125	141	156	171	186
14	106	125	143	160	178	195	212
15	120	141	161	181	201	220	239
16		158	180	203	225	246	268
17		175	201	225	250	274	298
18			222	249	276	303	329
19			244	274	304	333	362
20			267	300	332	364	396
<u>DRY</u> ^{4/}							
6	10	12	13	15			
7	13	15	18	20			
8	17	20	22	25	28		
9	21	24	28	31	35	38	
10	25	29	33	38	42	46	50
11	29	35	40	45	50	55	59
12	34	40	46	52	58	64	69
13	40	47	53	60	67	74	80
14	45	53	61	69	76	84	91
15	51	60	69	78	86	95	103
16		68	77	87	97	106	116
17		75	86	97	108	119	129
18			96	108	120	131	143
19			105	119	132	145	158
20			115	130	144	159	173

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -1.46928 + 0.87586 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -1.90676 + 0.89244 \log_{10} D^2Th.$

Table 15.--Predicted weight of wood and bark in main stem to 2-inch
d.i.b. top for longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- Pounds -----							
<u>GREEN</u> ^{3/}							
6	302	360	417	474			
7	406	484	561	638			
8	525	625	725	825	924		
9	658	784	910	1,034	1,158	1,282	
10	806	961	1,114	1,267	1,418	1,570	1,720
11	968	1,154	1,338	1,521	1,704	1,885	2,066
12	1,145	1,364	1,582	1,798	2,014	2,229	2,443
13	1,335	1,591	1,845	2,098	2,349	2,600	2,849
14	1,540	1,834	2,128	2,419	2,709	2,998	3,286
15	1,758	2,095	2,429	2,762	3,093	3,423	3,752
16		2,372	2,750	3,127	3,502	3,875	4,247
17		2,665	3,090	3,514	3,935	4,355	4,773
18			3,449	3,922	4,392	4,861	5,327
19			3,827	4,352	4,874	5,393	5,911
20			4,224	4,803	5,379	5,952	6,523
<u>DRY</u> ^{4/}							
6	164	195	227	259			
7	221	264	307	349			
8	287	342	398	453	508		
9	361	431	501	570	640	709	
10	443	529	615	700	785	870	955
11	533	637	740	843	946	1,048	1,150
12	632	755	877	999	1,121	1,242	1,363
13	739	882	1,025	1,168	1,310	1,452	1,593
14	853	1,019	1,185	1,350	1,514	1,678	1,841
15	976	1,166	1,355	1,544	1,732	1,919	2,106
16		1,323	1,537	1,751	1,964	2,176	2,388
17		1,489	1,730	1,971	2,210	2,450	2,688
18			1,934	2,203	2,471	2,738	3,005
19			2,149	2,448	2,746	3,043	3,339
20			2,375	2,705	3,035	3,363	3,690

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -0.65002 + 0.96146 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -0.96015 + 0.97497 \log_{10} D^2Th.$

Table 16.--Predicted weight of wood excluding bark in main stem to
2-inch d.i.b. top for longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- Pounds -----							
<u>GREEN</u> ^{3/}							
6	263	315	367	419			
7	357	427	497	567			
8	464	556	647	738	829		
9	586	701	816	931	1,046	1,160	
10	721	863	1,005	1,146	1,287	1,428	1,568
11	870	1,041	1,212	1,383	1,553	1,723	1,893
12	1,033	1,236	1,439	1,642	1,844	2,045	2,247
13	1,209	1,448	1,685	1,922	2,159	2,395	2,631
14	1,400	1,675	1,950	2,224	2,498	2,772	3,045
15	1,604	1,919	2,234	2,548	2,862	3,175	3,488
16		2,180	2,537	2,894	3,251	3,606	3,961
17		2,456	2,859	3,262	3,663	4,064	4,464
18			3,200	3,651	4,100	4,549	4,997
19			3,560	4,061	4,561	5,060	5,559
20			3,939	4,493	5,046	5,599	6,150
<u>DRY</u> ^{4/}							
6	139	167	195	223			
7	190	228	266	304			
8	248	298	348	398	448		
9	314	378	441	504	568	631	
10	389	467	545	623	702	780	859
11	471	566	660	755	850	945	1,040
12	561	674	787	900	1,013	1,126	1,239
13	659	791	924	1,057	1,190	1,323	1,456
14	765	919	1,073	1,227	1,381	1,536	1,690
15	879	1,055	1,232	1,410	1,587	1,764	1,942
16		1,202	1,403	1,605	1,807	2,009	2,211
17		1,358	1,585	1,813	2,041	2,269	2,498
18			1,778	2,034	2,290	2,546	2,802
19			1,983	2,268	2,553	2,839	3,124
20			2,198	2,514	2,831	3,147	3,464

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -0.78784 + 0.98563 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -1.13120 + 1.00588 \log_{10} D^2Th.$

Table 17.--Predicted weight of bark in main stem to 2-inch d.i.b. top
for longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110

----- Pounds -----

GREEN^{3/}

6	40	45	51	56			
7	49	57	63	70			
8	60	69	77	85	92		
9	71	82	91	101	110	118	
10	83	95	106	117	128	138	148
11	96	109	122	135	147	158	170
12	109	124	139	153	167	180	193
13	122	139	156	172	187	202	217
14	136	155	174	191	208	225	241
15	150	172	192	212	231	249	267
16		189	211	232	253	273	293
17		206	230	254	277	299	320
18			250	276	301	325	348
19			271	299	325	351	377
20			292	322	351	379	406

DRY^{4/}

6	25	29	32	35			
7	32	36	40	44			
8	38	44	49	54	58		
9	45	52	58	64	69	75	
10	53	60	67	74	80	87	93
11	60	69	77	85	92	100	107
12	69	78	87	96	105	113	121
13	77	88	98	108	117	127	136
14	86	98	109	120	131	141	151
15	94	108	120	132	144	156	167
16		118	132	145	158	171	183
17		129	144	159	173	186	199
18			156	172	187	202	217
19			169	186	203	219	234
20			182	200	218	235	252

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\text{Log}_{10} Y = -0.77468 + 0.72855 \text{Log}_{10} D^2\text{Th.}$

^{4/} $\text{Log}_{10} Y = -0.93976 + 0.71954 \text{Log}_{10} D^2\text{Th.}$

Table 18.--Predicted weight of crown material (branchwood, branchbark, and needles) in longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- Pounds -----							
<u>GREEN</u> ^{3/}							
6	46	56	67	78			
7	65	80	95	110			
8	88	108	128	149	170		
9	114	140	167	194	222	250	
10	145	178	212	246	281	317	353
11	180	221	263	305	349	393	437
12	219	269	319	371	424	478	532
13	262	322	383	445	508	572	637
14	310	380	452	526	601	676	753
15	362	444	528	614	702	790	880
16		514	611	711	812	914	1,018
17		589	701	815	930	1,048	1,167
18			797	927	1,058	1,192	1,327
19			901	1,047	1,196	1,347	1,499
20			1,011	1,175	1,342	1,512	1,683
<u>DRY</u> ^{4/}							
6	22	27	32	37			
7	31	38	45	53			
8	42	52	61	72	82		
9	55	67	80	94	107	121	
10	70	86	102	119	136	153	171
11	87	107	127	148	169	191	213
12	106	130	155	180	206	233	259
13	127	156	186	216	248	279	311
14	150	185	220	256	293	331	369
15	176	216	258	300	343	387	431
16		250	298	348	398	448	500
17		287	343	399	457	515	574
18			390	455	520	587	654
19			442	514	588	663	740
20			497	578	661	746	831

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -2.00999 + 1.12764 \log_{10} D^2 Th.$

^{4/} $\log_{10} Y = -2.37618 + 1.14054 \log_{10} D^2 Th.$

Table 19.--Predicted weight of wood and bark in branches for longleaf
pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- <u>Pounds</u> -----							
<u>GREEN</u> ^{3/}							
6	24	30	36	43			
7	35	44	54	63			
8	49	61	74	88	102		
9	65	82	100	118	137	156	
10	85	107	130	154	178	204	229
11	108	136	165	195	227	259	292
12	135	169	206	243	282	322	363
13	165	207	251	297	345	394	444
14	198	250	303	358	415	474	535
15	236	297	360	426	494	564	636
16		349	424	501	581	664	748
17		407	494	584	677	773	872
18			570	674	782	893	1,006
19			653	772	896	1,023	1,153
20			743	879	1,019	1,164	1,312
<u>DRY</u> ^{4/}							
6	12	16	19	22			
7	18	23	28	33			
8	25	32	39	46	53		
9	34	43	52	61	71	81	
10	44	56	67	80	92	105	118
11	56	71	86	101	117	133	150
12	70	88	106	125	145	166	187
13	85	107	130	153	177	202	228
14	103	129	156	184	213	243	274
15	122	153	185	219	253	289	325
16		180	217	257	297	339	382
17		209	253	299	346	394	444
18			292	344	399	455	512
19			334	394	456	520	586
20			379	448	518	591	665

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -2.72222 + 1.25770 \log_{10} D^2 Th.$

^{4/} $\log_{10} Y = -2.95713 + 1.24480 \log_{10} D^2 Th.$

Table 20.--Predicted weight of branchwood in longleaf pine trees 6 to 20
inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110

- - - - - Pounds - - - - -

GREEN^{3/}

6	14	18	22	26			
7	21	27	33	39			
8	30	38	47	56	66		
9	41	52	64	77	90	104	
10	54	69	85	102	120	138	157
11	70	90	110	132	154	178	202
12	89	113	139	167	195	225	255
13	110	140	173	206	242	278	316
14	134	171	210	252	295	340	386
15	161	206	253	303	355	409	464
16		245	301	360	422	486	552
17		288	354	424	496	572	650
18			413	494	579	667	757
19			478	571	669	771	876
20			548	656	768	884	1,005

DRY^{4/}

6	7	9	11	13			
7	10	13	16	19			
8	15	19	23	28	33		
9	20	26	32	38	45	51	
10	27	34	42	51	59	68	77
11	35	44	55	65	76	88	100
12	44	56	69	82	96	111	126
13	54	69	85	102	119	137	156
14	66	85	104	124	145	167	190
15	80	102	125	149	175	201	229
16		121	148	178	208	239	272
17		142	175	209	244	281	320
18			203	243	285	328	372
19			235	281	329	379	430
20			270	322	377	434	493

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -3.22660 + 1.34140 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -3.51387 + 1.33673 \log_{10} D^2Th.$

Table 21.--Predicted weight of branchbark in longleaf pine trees 6 to 20
inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110

----- Pounds -----

GREEN^{3/}

6	10	12	15	17			
7	14	17	20	23			
8	19	23	27	31	35		
9	24	30	35	40	46	51	
10	30	37	44	50	57	64	71
11	37	45	54	62	70	79	87
12	45	55	65	75	85	95	105
13	54	65	77	89	101	113	125
14	63	76	90	104	118	132	147
15	73	89	105	121	137	154	170
16		102	120	139	158	177	196
17		116	137	158	180	201	223
18			155	179	203	227	252
19			174	201	228	256	283
20			194	224	255	285	316

DRY^{4/}

6	6	7	8	10			
7	8	10	11	13			
8	11	13	15	18	20		
9	14	17	20	23	26	29	
10	17	21	25	29	32	36	40
11	21	26	30	35	40	44	49
12	25	31	37	42	48	54	59
13	30	37	43	50	57	64	70
14	35	43	51	59	67	75	83
15	41	50	59	68	77	86	96
16		57	68	78	89	99	110
17		65	77	89	101	113	125
18			87	101	114	128	141
19			98	113	128	143	159
20			109	126	143	160	177

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -2.49769 + 1.07628 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -2.72978 + 1.07216 \log_{10} D^2Th.$

Table 22.--Predicted green volume of wood and bark in total tree for
 longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
-----Cubic feet-----							
<u>WOOD</u> ^{3/}							
6	4.1	5.0	5.8	6.7			
7	5.7	6.9	8.1	9.3			
8	7.5	9.1	10.7	12.3	13.9		
9	9.6	11.7	13.7	15.8	17.8	19.9	
10	12.0	14.5	17.1	19.7	22.2	24.8	27.5
11	14.7	17.8	20.9	24.0	27.2	30.3	33.5
12	17.6	21.3	25.1	28.8	32.6	36.4	40.3
13	20.8	25.2	29.6	34.1	38.6	43.1	47.6
14	24.3	29.4	34.6	39.8	45.1	50.3	55.6
15	28.1	34.0	40.0	46.0	52.1	58.2	64.3
16		39.0	45.8	52.7	59.6	66.6	73.6
17		44.3	52.0	59.9	67.7	75.7	83.6
18			58.7	67.5	76.4	85.3	94.3
19			65.7	75.6	85.5	95.5	105.6
20			73.2	84.2	95.3	106.4	117.6
<u>DRY</u> ^{4/}							
6	1.3	1.4	1.6	1.8			
7	1.6	1.9	2.1	2.4			
8	2.0	2.3	2.6	2.9	3.2		
9	2.4	2.8	3.2	3.5	3.9	4.2	
10	2.9	3.3	3.8	4.2	4.6	5.0	5.4
11	3.3	3.9	4.4	4.9	5.4	5.9	6.3
12	3.8	4.5	5.1	5.6	6.2	6.8	7.3
13	4.4	5.1	5.8	6.4	7.1	7.7	8.3
14	4.9	5.7	6.5	7.2	8.0	8.7	9.4
15	5.5	6.4	7.3	8.1	8.9	9.7	10.5
16		7.1	8.1	9.0	9.9	10.8	11.6
17		7.9	8.9	9.9	10.9	11.9	12.8
18			9.8	10.9	12.0	13.0	14.1
19			10.7	11.9	13.1	14.2	15.4
20			11.6	12.9	14.2	15.5	16.7

continued

Table 22.--Predicted green volume of wood and bark in total tree for
 longleaf pine trees 6 to 20 inches d.b.h.^{1/} (continued)

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
-----Cubic feet-----							
WOOD AND BARK ^{5/}							
6	5.3	6.4	7.5	8.6			
7	7.3	8.8	10.2	11.7			
8	9.5	11.5	13.4	15.3	17.2		
9	12.1	14.5	17.0	19.4	21.8	24.3	
10	14.9	18.0	21.0	24.0	27.0	30.0	33.0
11	18.1	21.7	25.4	29.0	32.7	36.4	40.0
12	21.6	25.9	30.3	34.6	39.0	43.3	47.7
13	25.3	30.4	35.5	40.6	45.8	50.9	56.0
14	29.4	35.3	41.2	47.2	53.1	59.0	65.0
15	33.8	40.6	47.4	54.2	61.0	67.8	74.7
16		46.2	54.0	61.7	69.5	77.2	85.0
17		52.2	61.0	69.7	78.5	87.3	96.0
18			68.4	78.2	88.0	97.9	107.7
19			76.2	87.2	98.2	109.1	120.1
20			84.5	96.7	108.8	121.0	133.2

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -2.80224 + 1.04936 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -2.54434 + 0.81138 \log_{10} D^2Th.$

^{5/} $\log_{10} Y = -2.54553 + 1.00570 \log_{10} D^2Th.$

Table 23.--Predicted green volume of wood and bark in main stem to 2-inch
d.i.b. top for longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
- - - - - <u>Cubic feet</u> - - - - -							
<u>WOOD</u> ^{3/}							
6	3.9	4.7	5.5	6.3			
7	5.3	6.4	7.5	8.6			
8	7.0	8.5	9.9	11.3	12.8		
9	8.9	10.7	12.6	14.4	16.2	18.1	
10	11.1	13.3	15.6	17.9	20.1	22.4	24.7
11	13.4	16.2	18.9	21.7	24.5	27.2	30.0
12	16.0	19.3	22.6	25.9	29.2	32.5	35.8
13	18.9	22.7	26.6	30.5	34.4	38.3	42.2
14	22.0	26.4	30.9	35.5	40.0	44.5	49.0
15	25.3	30.4	35.6	40.8	46.0	51.2	56.4
16		34.7	40.6	46.5	52.5	58.4	64.4
17		39.3	46.0	52.7	59.4	66.1	72.9
18			51.6	59.2	66.7	74.3	81.9
19			57.7	66.1	74.5	82.9	91.4
20			64.0	73.3	82.7	92.1	101.5
<u>BARK</u> ^{4/}							
6	1.0	1.2	1.3	1.4			
7	1.3	1.5	1.6	1.8			
8	1.6	1.8	2.0	2.2	2.4		
9	1.8	2.1	2.3	2.6	2.8	3.0	
10	2.1	2.4	2.7	3.0	3.2	3.5	3.7
11	2.4	2.8	3.1	3.4	3.7	3.9	4.2
12	2.7	3.1	3.5	3.8	4.1	4.5	4.8
13	3.1	3.5	3.9	4.3	4.6	5.0	5.3
14	3.4	3.9	4.3	4.7	5.1	5.5	5.9
15	3.8	4.3	4.7	5.2	5.7	6.1	6.5
16		4.7	5.2	5.7	6.2	6.7	7.1
17		5.1	5.7	6.2	6.7	7.2	7.7
18			6.1	6.7	7.3	7.9	8.4
19			6.6	7.2	7.9	8.5	9.0
20			7.1	7.8	8.5	9.1	9.7

continued

Table 23.--Predicted green volume of wood and bark in main stem to 2-inch d.i.b. top for longleaf pine trees 6 to 20 inches d.b.h.^{1/} (continued)

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- Cubic feet -----							
WOOD AND BARK ^{5/}							
6	4.9	5.9	6.8	7.8			
7	6.6	7.9	9.2	10.5			
8	8.6	10.3	11.9	13.6	15.2		
9	10.8	12.9	15.0	17.1	19.1	21.2	
10	13.3	15.8	18.4	21.0	23.5	26.0	28.6
11	16.0	19.1	22.2	25.2	28.3	31.3	34.4
12	18.9	22.6	26.2	29.9	33.5	37.1	40.7
13	22.1	26.4	30.6	34.9	39.1	43.3	47.5
14	25.5	30.5	35.4	40.3	45.2	50.0	54.9
15	29.2	34.8	40.5	46.1	51.7	57.2	62.8
16		39.5	45.9	52.2	58.6	64.9	71.2
17		44.4	51.6	58.8	65.9	73.0	80.1
18			57.7	65.7	73.6	81.5	89.5
19			64.1	72.9	81.8	90.6	99.4
20			70.8	80.6	90.3	100.1	109.8

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -2.72558 + 1.01904 \log_{10} D^2Th.$

^{4/} $\log_{10} Y = -2.25358 + 0.69804 \log_{10} D^2Th.$

^{5/} $\log_{10} Y = -2.47035 + 0.97145 \log_{10} D^2Th.$

Table 24.--Predicted green volume of wood and bark in branches for
longleaf pine trees 6 to 20 inches d.b.h.^{1/}

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- Cubic feet -----							
<u>WOOD</u> ^{3/}							
6	0.2	0.3	0.4	0.4			
7	.4	.5	.6	.7			
8	.5	.7	.8	.9	1.1		
9	.7	.9	1.1	1.3	1.5	1.7	
10	.9	1.2	1.4	1.7	2.0	2.3	2.6
11	1.2	1.5	1.8	2.2	2.5	2.9	3.3
12	1.5	1.9	2.3	2.7	3.2	3.6	4.1
13	1.8	2.3	2.8	3.4	3.9	4.5	5.1
14	2.2	2.8	3.4	4.1	4.7	5.4	6.2
15	2.6	3.3	4.1	4.9	5.7	6.5	7.4
16		4.0	4.8	5.8	6.7	7.7	8.7
17		4.6	5.7	6.7	7.9	9.0	10.2
18			6.6	7.8	9.1	10.5	11.8
19			7.6	9.0	10.5	12.0	13.6
20			8.6	10.3	12.0	13.8	15.6
<u>BARK</u> ^{4/}							
6	0.2	0.3	0.3	0.4			
7	.3	.4	.5	.5			
8	.4	.5	.6	.7	0.8		
9	.6	.7	.8	.9	1.1	1.2	
10	.7	.9	1.0	1.2	1.3	1.5	1.7
11	.9	1.1	1.2	1.4	1.6	1.8	2.0
12	1.0	1.3	1.5	1.7	2.0	2.2	2.4
13	1.2	1.5	1.8	2.1	2.3	2.6	2.9
14	1.5	1.8	2.1	2.4	2.7	3.1	3.4
15	1.7	2.1	2.4	2.8	3.2	3.6	3.9
16		2.4	2.8	3.2	3.6	4.1	4.5
17		2.7	3.2	3.7	4.1	4.6	5.1
18			3.6	4.1	4.7	5.2	5.8
19			4.0	4.6	5.3	5.9	6.5
20			4.5	5.2	5.9	6.6	7.3

continued

Table 24.--Predicted green volume of wood and bark in branches for
 longleaf pine trees 6 to 20 inches d.b.h.^{1/} (continued)

D.b.h. (inches)	Total tree height (feet) ^{2/}						
	50	60	70	80	90	100	110
----- Cubic feet -----							
<u>WOOD AND BARK</u> ^{5/}							
6	0.5	0.6	0.7	0.8			
7	.7	.9	1.0	1.2			
8	1.0	1.2	1.4	1.7	1.9		
9	1.3	1.6	1.9	2.2	2.6	2.9	
10	1.6	2.0	2.5	2.9	3.3	3.8	4.2
11	2.1	2.6	3.1	3.6	4.2	4.8	5.4
12	2.5	3.2	3.8	4.5	5.2	5.9	6.6
13	3.1	3.9	4.6	5.5	6.3	7.1	8.0
14	3.7	4.6	5.6	6.5	7.5	8.5	9.6
15	4.4	5.4	6.6	7.7	8.9	10.1	11.3
16		6.4	7.7	9.0	10.4	11.8	13.2
17		7.4	8.9	10.4	12.0	13.7	15.3
18			10.2	12.0	13.8	15.7	17.6
19			11.6	13.7	15.8	17.9	20.1
20			13.2	15.5	17.8	20.3	22.7

^{1/} Blocked-in area indicates range of data.

^{2/} Includes 1-foot stump allowance.

^{3/} $\log_{10} Y = -4.84899 + 1.30101 \log_{10} D^2 Th.$

^{4/} $\log_{10} Y = -4.10690 + 1.07007 \log_{10} D^2 Th.$

^{5/} $\log_{10} Y = -4.26121 + 1.20985 \log_{10} D^2 Th.$